

EP 3005 – ADDITIONAL REQUIREMENTS FOR HORIZONTAL DIRECTIONAL DRILLING (HDD) / DIRECTIONAL BORING – SPECIFICATION 02082A

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PART 1 - GENERAL

1.1 SCOPE

This engineering practice supplements EP3005 – PIPELINE OCCUPANCY, and describes items to be included in the design and installation of buried pipelines using the Directional Boring/Horizontal Directional Drilling (HDD) method adjacent and proximate to Amtrak tracks.

1.2 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 DEFINITIONS

For all definitions, refer to EP3005 – PIPELINE OCCUPANCY, Section 02081A Pipeline Occupancy.

1.4 SUBMISSION REQUIREMENTS

In addition to the plans and documentation specified in EP3005, Section 02081A, Pipeline Occupancy, the Applicant shall submit the following preliminary information with the request for consideration of this type of installation:

1. Application form.
2. Pre-bore survey grid line with angles and depths defined.
3. Actual planned depth of pipe under each railroad track. The plan and profile views must show the entire bore, including the sending and receiving pits, regardless of the railroad right-of-way limits.
4. Construction procedure, including a general description and the manufacturer's catalog information of equipment to be used.
5. Minimum allowable pipe bend radius vs. installation radius.
6. Specifications and capacities of the bore machine. This includes:
 - a. Maximum & intended capacities
 - b. Maximum & intended drilling RPM
 - c. Maximum & intended drilling PSI
 - d. Maximum & intended GPM
7. Slurry mix design appropriate to the anticipated geological conditions. Material list including bentonite and bentonite additives proposed for the project along with Material Safety Data Sheets (MSDS) for all materials used on the site, and water source for drilling operations.
8. A defined slurry recovery method. Disposal on Amtrak property or within Amtrak drainage ditches/facilities is prohibited.
9. Statement of expected soil conditions and statement of all drill heads on site for expected and unexpected soil conditions.
10. Submit calculations showing the theoretical settlement for the proposed installation is within safety limits (less than half the maximum allowable settlement) for the FRA class

of track as established by the Amtrak Track Department. See *Sketch 1 – Calculation of Theoretical Settlement* for approved method.

11. Statement that once the bore enters Amtrak property, the work will be continuous until the drilling is complete and the pipe is pulled into place.
12. Statement that the bore will be tracked constantly, with the location and depth marked every 10 feet.
13. Qualifications of drilling contractor, including specific instances of previous successful experience in drilling under railroad and other sensitive surface facilities.

If Amtrak determines this method of installation is acceptable, final design plans and specifications are to be prepared and submitted for approval.

The Applicant shall revise and resubmit plans and calculations as many times as necessary, until a complete and correct site-specific work plan for directional boring/HDD has been approved.

PART 2 - PRODUCTS (Not Used)

PART 3 - CONSTRUCTION

Due to the unique circumstances and conditions encountered along the railroad Right-of-Way (ROW), each HDD request will be reviewed at Amtrak's sole discretion on a case by case basis. The applicant utilizing the HDD method of installation shall meet all the requirements found in EP 3005, Section 02082A, Horizontal Directional Drilling / Directional Boring. If HDD is deemed unacceptable by Amtrak, the applicant may consider other installation techniques contained within EP 3005, Section 02081A, Pipeline Occupancy, for the installation of the pipeline or utility crossing.

Contractors installing buried pipelines using the directional boring/horizontal directional drilling (HDD) method shall conform to the following:

1. **USE OF HDD:** This method consists of setting up specialized drilling equipment on existing grade and boring a small diameter pilot hole on the desired vertical and horizontal alignment, using a mechanical cutting head with a high-pressure fluid (bentonite slurry) to remove the cuttings. The drill string is advanced with the bentonite slurry pumped through the drill string to the cutting head and then forced back along the outside of the drill string, carrying the cuttings back to the surface for removal. When the cutting head reaches the far side of the crossing, it is removed and a reamer is attached to the lead end of the drill string. The pipeline is attached to the reamer and the pilot hole is then back reamed while the pipeline is pulled into place.
2. For pipelines conveying gas or liquid substances, only steel pipe may be installed under track(s) and/or Amtrak right-of-way utilizing HDD.
3. For wireline installations, including fiber optic cable, HDPE pipe may be installed as the outermost pipe. Bundling is prohibited. All inner ducts must have an outer casing pipe. If the commodity to be conveyed permits the use of HDPE pipe, it must be grade SDR 11 or thicker wall.
4. Bore size shall not be any greater than is necessary.

Maximum Reamed Diameter (d_b) by Product Diameter (d_p)	
d_p	d_b
< 8" (< 200 mm)	$d_p + 4"$ (100 mm)
8" - 24" (200 - 600 mm)	$d_p \times 1.5$
> 24" (>600 mm)	$d_p + 12"$ (300 mm)

Bennett, David, and Samuel T. Ariaratnam. Horizontal Directional Drilling Good Practices Guidelines. Third ed. HDD Consortium, 2008.

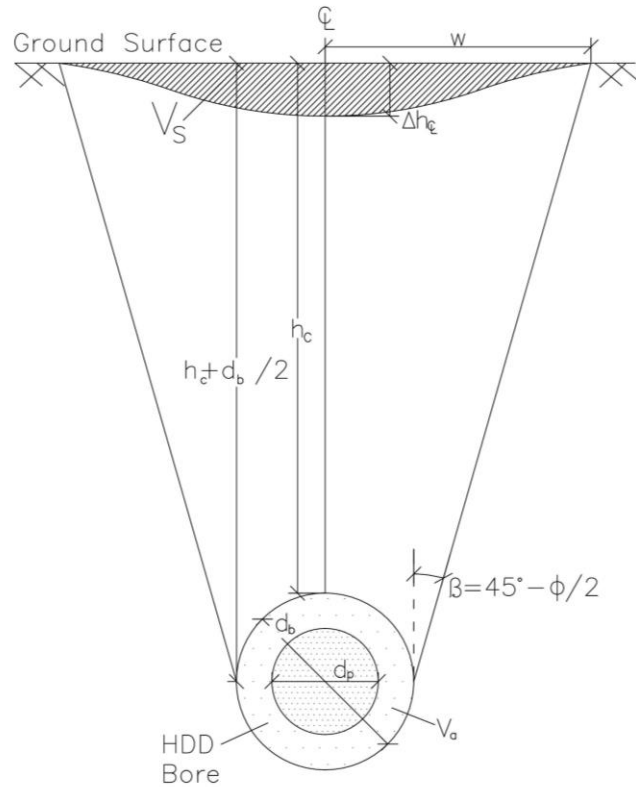
5. The launching and receiving pits, if used, must be situated outside of the railroad influence zone.
6. The Contractor shall provide Amtrak with a detailed schedule of proposed construction operations, detailing each step of the proposed construction operations in proximity to Amtrak tracks, so that Amtrak may review and approve the proposed operations, and may properly inspect and monitor operations.
 - a. The Contractor must submit a Boring Plan that describes the anticipated rig capacity, the proposed equipment, and the method for advancing the borehole through expected soil conditions, angles, depth, and exact location of the exit ditch, the pilot hole diameter, the proposed reaming plan, including the diameter of pre-reams/back-reams and diameter of the final reamed bore hole, and the contingency equipment and plans for dealing with soil conditions that a soil engineering could reasonably expect to be encountered at the proposed HDD installation site. The contractor needs to address the condition when obstructions are encountered and what will be the remedial actions taken to stabilize the bore hole in order to prevent settlement and contamination of the track structure. The Boring Plan will also need to address the anticipated hours of operation during the HDD bore hole drilling and installation process, the minimum number of personnel, and their responsibilities on-duty and on-site during all HDD drilling operations. Consideration for working hours must be given to minimize risk to railroad operations during drilling operations.
 - b. The Contractor must refer to Part 5 of this document to review the "Frac-Out Contingency Plan" (sometimes referred to as Fracture Mitigation or Inadvertent Return of Materials Plan) established by Amtrak's Track Department, which details the method of monitoring quantity and capturing the return of drilling fluids with particular attention to variation from proposed plan (i.e. volumes, pressure, or consistency), responsibilities of the Contractor Project Engineer, and the proper field response to a "frac-out" or inadvertent return of materials occurrence.
 - 1) Although utmost care must be taken against inadvertent return of materials, if it does occur, the drilling operations should cease immediately and the bore hole stabilized to prevent further contamination and settlement of the track structure. Amtrak forces will complete the clean-up and repair of the contaminated track structure at the sole cost of the applicant.
 - c. During the pilot bore operations the drill head must be continuously monitored while crossing railroad property. The contractor shall establish a Survey Grid Line and provide a program of monitoring and documenting the actual location of the bore hole during drilling operations. If the location of the drill head is "lost" during the pilot bore drilling operations, the contractor will immediately cease operations, stabilize the bore hole, and endeavor to re-establish the drill head position before resuming any drilling.

7. The ground and track must be monitored for movement during the drilling, reaming, and pullback processes. The inspection shall be carried out by a Resident Engineer provided by the Applicant as described in EP3005, Section 02081A, Horizontal Directional Drilling / Directional Boring.
8. No demobilization may occur until the casing pipe is in place or bore is abandoned and stabilized.

PART 4 - INFORMATION SKETCHES

The following Information Sketches are attached:
Sketch 1 – Calculation of Theoretical Settlement

Reminder: HDD is not a standard approved installation method on Amtrak right-of-way, and will require advanced engineering review and approval.



VARIABLE DEFINITIONS

- C: CENTERLINE OF PIPE
- W: SETTLEMENT TROUGH HALF-WIDTH
- Δhc: SETTLEMENT TROUGH DEPTH AT CENTERLINE (MAXIMUM SETTLEMENT)
- hc: DEPTH OF CLEARANCE ABOVE CROWN OF BORE (NOT PIPE)
- db: REAMED (BORE) DIAMETER
- dp: PRODUCT PIPE DIAMETER
- Vs: SETTLEMENT TROUGH VOLUME PER UNIT OF BORE LENGTH
- Va: VOLUME OF ANNULUS PER UNIT LENGTH OF BORE LENGTH
- φ: FRICTION ANGLE OF SOIL

EQUATIONS

- (1) $\Delta h_c = \frac{V_s}{W}$
- (2) $V_a = \frac{\pi}{4} \cdot (d_b^2 - d_p^2) \cdot (h_c + \frac{d_b}{2})$
- (3) $V_e = \frac{2}{3} V_a$
- (4) $w = \frac{d_b}{2} + (h_c + \frac{d_b}{2}) \cdot \tan(45^\circ - \frac{\phi}{2})$

CALCULATION OF THEORETICAL SETTLEMENT

Bennett, David, and Samuel T. Ariaratnam. Horizontal Directional Drilling Good Practices Guidelines. Third ed. HDD Consortium, 2008.

 <p style="font-size: 8px;">This material is owned by and is the sole and exclusive property of the National Railroad Passenger Corporation (Amtrak), Office of Engineering, and is supplied on a confidential basis solely for use in connection with the design and construction of Amtrak facilities and equipment. The reproduction, display, sale or other disposition of this document without the express written consent of the National Railroad Passenger Corporation, Office of Engineering, is prohibited.</p>	<p>Office of Chief Engineer STRUCTURES</p> <p>National Railroad Passenger Corporation 30th Street Station, Philadelphia, Pennsylvania 19104</p>	<p style="font-size: 24px; color: yellow;">SKETCH 1</p> <p>EP3005 SPEC 02082A</p>	File No:	
			Design No:	
			Sheet No.	1 of 1
			Fig. No.	SK-1
			Design	Drawn JMR Date 5/06/11

PART 5 - ADDITIONAL TECHNICAL INFORMATION

AMTRAK TRACK DEPARTMENT FRAC-OUT CONTINGENCY PLAN (FCP)

5.1 INTRODUCTION AND PURPOSE

A frac-out is the condition where drilling fluid is released through either fractured bedrock or soil into the surrounding rock or soil and travels toward the surface fouling subballast and ballast in the railroad roadbed. Drilling operations have a potential to release drilling fluids into the surface environment through frac-outs.

Because drilling fluids consist largely of a bentonite clay-water mixture, they are not classified as toxic or hazardous substances as defined by EPA's 40 CFR, Part 261. However, if the drilling fluids are released into the water bodies, the bentonite has the potential to adversely impact fish and invertebrates. Therefore, they must be contained and disposed of properly.

Although drilling fluid seepage associated with a frac-out is most likely to occur near the bore entry and exit points where the drill head is shallow, frac-outs can occur in any location along the bore. This Frac-out Contingency Plan (FCP) establishes operational procedures and responsibilities for the prevention, containment, and clean-up of frac-outs associated with proposed drilling utility projects. All personnel and Subcontractors responsible for the work must adhere to this plan during the drilling process.

The specific objectives of this plan are the following:

1. Minimize the potential for a frac-out associated with drilling activities;
2. Provide for timely detection of frac-outs;
3. Protect the environmentally sensitive riverbed and associated riparian vegetation;
4. Ensure an organized, timely, and "minimum-impact" response in the event of a frac-out and release of drilling bentonite; and
5. Ensure that all appropriate notifications are made immediately to the Amtrak Project Manager, the on-site contractor, and all on-site personnel.

5.2 DESCRIPTION OF WORK

Drilling operations will be halted by the drill rig operators immediately upon detection of a drop in the drilling pressure or other evidence of a frac-out. The cleanup or containment of all spills shall begin immediately and in accordance with procedures identified in this plan. The Contractor shall appoint a representative herein referred to as "The Contractor Project Engineer" to handle responsibility of implementing and enforcing the FCP. The Contractor Project Engineer shall be notified immediately of any spills by the on-site Drilling Foreman or Drilling Supervisor and shall be consulted by Amtrak's Environmental Group regarding cleanup procedures. The Contractor Project Engineer should be aware that other agencies may be involved in the cleanup procedures.

In the event of a frac-out, the Contractor Project Engineer will conduct an evaluation of the situation, recommend the type and level of response warranted including the level of notification required, and direct recommended mitigation actions based on the emergency guidelines and required actions discussed below:

1. Drilling will stop immediately for at least the period of time needed for both a thorough evaluation and recommendation by the Contractor Project Engineer;

2. Work must not take place without Amtrak authorization;
3. The bore stem will be pulled back to relieve pressure on the frac-out;
4. The Contractor Project Engineer will be notified by the on-site Contractor Drilling Foreman or Supervisor that a frac-out has occurred. The Contractor Project Engineer must ensure that the Amtrak Project Engineer, all on-site personnel, and Amtrak's Environmental Group are notified and that adequate response actions are taken under the consultation of Amtrak's Environmental Group;
5. If the frac-out is minor, easily contained, has not reached the surface, and is not threatening sensitive resources, a leak-stopping compound shall be used to block the frac-out. If the use of a leak-stopping compound is not fully successful or the problem cannot be stopped within the allotted time or track outage, the borehole must be grouted in place and abandoned. Abandonment of the bore will only be required when all efforts to control the frac-out within the existing bore have failed. At that point, Amtrak's EP 3005 Section 02081A "Pipeline Occupancy Specifications" must be followed. The appropriate mix and method of grouting the borehole must be used so as to not contribute to the problem;
6. A spill kit shall be on site and used if a small frac-out has reached the surface and can be handled without directing and containing the spill through berms, swales, or other methods;
7. If the frac-out has reached the surface and is within 25 feet of the centerline of the nearest track, all material contaminated with bentonite shall be removed by hand by Amtrak forces at the project's expense to a depth of at least the bottom of the subballast in the roadbed and to a width of at least 2 feet outside of the roadbed. However, for frac-outs that are entirely outside of a line that is 25 feet from the centerline of the nearest track, the Contractor must remove the material contaminated with bentonite in a similar manner and also at the project's expense. The method of removal must assure that roadbed drainage is not impeded and that the drainage is not altered to result in unfavorable conditions that cause erosion, roadbed instability, or standing water. Although removal of material contaminated with bentonite within 25 feet of the centerline of the nearest track is restricted to Amtrak forces within 25 feet of the centerline of the nearest track, containment and disposal of the material contaminated with bentonite is always the responsibility of the Contractor. For frac-outs within 25 feet of the centerline of the nearest track, the Contractor Project Engineer must direct all Contractor activities to take place at least 25 feet away from the centerline of the nearest track whenever it is possible to do so. Removal, containment, and disposal must be done as required by law at the project's expense. A dike or berm may be constructed around the frac-out to entrap released drilling fluid if necessary so that the spill does not spread further and does not reach water bodies either directly or indirectly through drainage. Clean material shall be placed and the area returned to pre-project contours. The Contractor Project Engineer must direct all activities performed by the Contractor described above in this paragraph;
8. If a frac-out occurs and has reached the surface and becomes widespread, the Contractor Project Engineer shall authorize a readily accessible vacuum truck and bulldozer stored either on-site or within 10 minutes off-site to be mobilized. Containment materials such as straw bales shall be on-site and readily available prior to and during all operations. The vacuum truck may be positioned at either end of the line of the drill so that the frac-out can be reached by crews on foot or may be pulled by a bulldozer so that contaminated material can be vacuumed; and
9. All mitigation procedures must not pose additional threats to sensitive resources.

5.3 CONTRACTOR PROJECT ENGINEER RESPONSIBILITIES

The Contractor Project Engineer has overall responsibility for implementing the FCP. The Contractor Project Engineer shall ensure that all workers are properly trained and familiar with the necessary procedures for response to a frac-out prior to commencement of drilling. For more details on training, see below. The Contractor Project Engineer shall ensure that he or she will be notified immediately by the on-site Drilling Foreman or Drilling Supervisor when a frac-out is detected. The Contractor Project Engineer will immediately notify the Amtrak Project Engineer. The Contractor Project Engineer will be responsible for ensuring that the site personnel are aware of the frac-out. With consultation with Amtrak's Environmental Group, the Contractor Project Engineer will be responsible for coordinating personnel, response procedures, clean-up procedures, disposal of recovered material, and timely reporting of the incident as described in Paragraph "g" above. Although Amtrak's Environmental Group will handle regulatory agency notification, the Contractor Project Engineer must delegate personnel experienced in the removal, transport, and disposal of drilling fluid. In addition, the Contractor Project Engineer shall ensure that all waste materials are properly containerized, labeled, and removed from the site and brought to an approved disposal facility. The Contractor Project Engineer must ensure that the material is properly recycled in an approved manner. The Contractor Project Engineer must provide all necessary follow-up response actions in coordination with the appropriate agency representatives as determined by Amtrak's Environmental Group. The Contractor Project Engineer will coordinate the mobilization of readily available equipment stored at off-site locations (e.g. vacuum trucks) on an as-needed basis. Because all cleanup activities will be done at the expense of the Contractor even if Amtrak forces provide the cleanup, the Contractor Project Engineer must ensure that all cleanup activities and time is documented and consistent with Amtrak records.

The Contractor Project Engineer shall be familiar with all aspects of the drilling activity, the contents of this FCP, and the conditions for approval under which the activity is permitted to take place. The Contractor Project Engineer shall have the authority to stop work and commit the resources (personnel and equipment) necessary to implement this plan. The Contractor Project Engineer shall assure that a copy of this plan is available on-site and accessible to all construction personnel.

Equipment – The Contractor Project Engineer shall ensure the following:

1. All equipment and vehicles are checked and maintained daily to prevent leaks of hazardous material;
2. Spill kits and spill containment materials are available on-site at all times and that the equipment is in good working order;
3. Equipment required to contain and clean up a frac-out release will either be available at the work site or readily available in an off-site location within 15 minutes of the bore site; and
4. If equipment is required to be operated near a riverbed, absorbent pads and plastic sheeting for placement beneath motorized equipment shall be used to protect the riverbed from engine fluids.

Training – Prior to the start of construction, the Contractor Project Engineer shall ensure that the crew members receive training in the following:

1. The provisions of the Frac-out Contingency Plan, equipment maintenance, and site specific permit and monitoring requirements;
2. Inspection procedures for release prevention and containment equipment and materials;
3. Contractor/Crew member responsibility in the event of a release;
4. Operation of release prevention and control equipment and the location of release control materials, as necessary and appropriate; and
5. Protocols for communication with agency representatives who may be on-site during the cleanup effort.

5.4 DRILLING PROCEDURES

The following procedures shall be followed each day prior to the start of work:

1. The Frac-out Contingency Plan (FCP) shall be available on-site during all construction;
2. The Contractor Project Engineer shall be on-site at any time that drilling is occurring or is scheduled to occur;
3. The Contractor Project Engineer shall ensure that a Job Briefing Meeting is held at the start of drilling to review the appropriate procedures to be followed in case of a frac-out. Questions shall be answered and clarification given on any point over which the drilling crew or other project staff has concerns.

Drilling pressures shall be closely monitored so they do not exceed those needed to penetrate the formation. Pressure levels shall be monitored constantly by the operator. Pressure levels shall be set at a minimum level to prevent frac-outs. During the pilot bore, maintain the drilled annulus. Cutters and reamers will be pulled back into previously drilled sections after each new joint of pipe is added.

Exit and entry pits shall be enclosed by silt fences and straw. A spill kit shall be on-site and used if a frac-out occurs. A vacuum truck shall be readily available either on-site or within 10 minutes of the drilling site prior to and during all drilling operations. Containment materials (straw, silt fencing, sand bags, frac-out spill kits, etc.) shall be staged on-site at locations where they are readily available and easily mobilized for immediate use in the event of an accidental release of drilling fluid (frac-out). If necessary, barriers (straw bales or sedimentation fences) between the bore site and the edge of the water source shall be constructed prior to drilling to prevent released bentonite material from reaching the water.

Once the drill rig is in place and drilling begins, the drill operator shall stop work whenever either the pressure in the drill rig drops or there is a lack of returns in the entrance pit. At this time the Contractor Project Engineer and the drill rig operator(s) shall work to coordinate the likely location of the frac-out. The location of the frac-out shall be recorded and include notes such as the measures taken to address the concern.

Water containing drilling fluid, silt, bentonite, or other pollutants derived from the equipment washing or other activities shall not be allowed to enter a lake, flowing stream, wetland, or any other water body. The bentonite used in the drilling process shall be either disposed of at an approved disposal facility or recycled in an approved manner. Other construction materials and wastes shall be recycled or disposed of as appropriate.

5.5 RESPONSE CLOSE-OUT PROCEDURES

When the release has been contained and the area affected has been cleaned in accordance with this FCP and to satisfaction of the on-site Amtrak representative, response close-out activities will be conducted at the direction of the Contractor Project Engineer and shall include the following:

1. The recovered drilling fluid will either be recycled or hauled to an approved facility for disposal. No recovered drilling fluids will be discharged into streams, storm drains, or any other water source;
2. All frac-out excavation and clean-up sites will be returned to pre-project contours using the clean material necessary; and
3. All containment measures (fiber rolls, straw bales, etc.) will be removed unless otherwise specified by the Contractor Project Engineer.

5.6 CONSTRUCTION RE-START

For small releases not requiring external notification, drilling may continue if the following occurs:

1. 100 percent containment is achieved through the use of a leak-stopping compound;
2. If the on-site Amtrak representative authorizes the continuation of drilling; and
3. The clean-up crew remains at the frac-out location throughout the construction period.

For releases requiring external notification and/or other agencies, construction activities will not restart without prior approval from the Amtrak Project Engineer.

5.7 NOTIFICATION

In the event of a frac-out that reaches a water source, the Contractor Project Engineer will notify the Amtrak Project Engineer so that the appropriate resource agencies can be notified through Amtrak's Environmental Group. All agency notifications will occur within 24 hours and proper documentation will be accomplished in a timely and complete manner. If deemed necessary by the Amtrak Environmental Group, the necessary agency information and contacts will be provided to the Contractor.

5.8 COMMUNICATING WITH REGULATORY AGENCY PERSONNEL

All employees and subcontractors will follow the following protocols when regulatory agency personnel arrive on site:

1. Regulatory agency personnel will be required to comply with appropriate safety rules;
2. Only the Amtrak Project Engineer is to coordinate communication with regulatory agency personnel. If deemed necessary by the Amtrak Environmental Group, the necessary agency information and contacts will be provided to the Contractor; and
3. All communication records (emails, etc.) must be copied to Amtrak.

5.9 DOCUMENTATION

The Contractor Project Engineer shall record the frac-out event in his or her daily log. The log report will include the following:

1. Details on the release event including:
 - a. An estimate of the amount of bentonite released;
 - b. The location, date, and time of the release;
 - c. How the release occurred;
 - d. The type of activity that was occurring around the area of the frac-out;
 - e. Description of any sensitive areas and their location to the frac-out;
 - f. Description of the methods used to clean up or secure the site;
 - g. A listing of the current permits obtained for the project
 - h. The size of the area impacted; and
 - i. The success of cleanup action.

5.10 PROJECT COMPLETION AND CLEAN-UP

1. All materials and any rubbish/construction debris shall be removed from the railroad property at the end of each workday.
2. Sump pits at bore entry and exits will be filled with clean material and returned to preexisting grade; and
3. All protective measures (fiber rolls, straw bales, silt fences, etc.) will be removed unless otherwise specified by the Amtrak Project Engineer.